

The background of the slide is a close-up of the American flag, showing the stars and stripes. Overlaid on the right side of the flag is a small, golden castle with multiple towers and a central archway.

MEASURING ECOSYSTEM RESTORATION BENEFITS FOR FISH PASSAGE/DAM REMOVAL PROJECTS

*BY
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ROCK ISLAND DISTRICT*

MAY 10, 2006



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Key Factors

- Habitat Quantity
- Habitat Quality
- Passage Efficiency of Alternatives
- Optimizing benefits and addressing unintended effects

Examples from projects

Why do fish move?



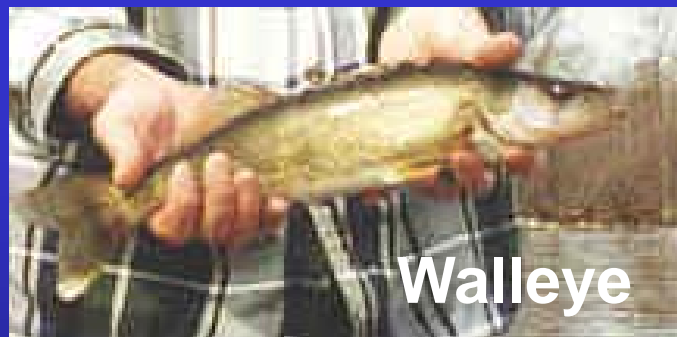
Midwest fish don't jump!



Smallmouth Bass



White Sucker



Walleye



Channel Catfish



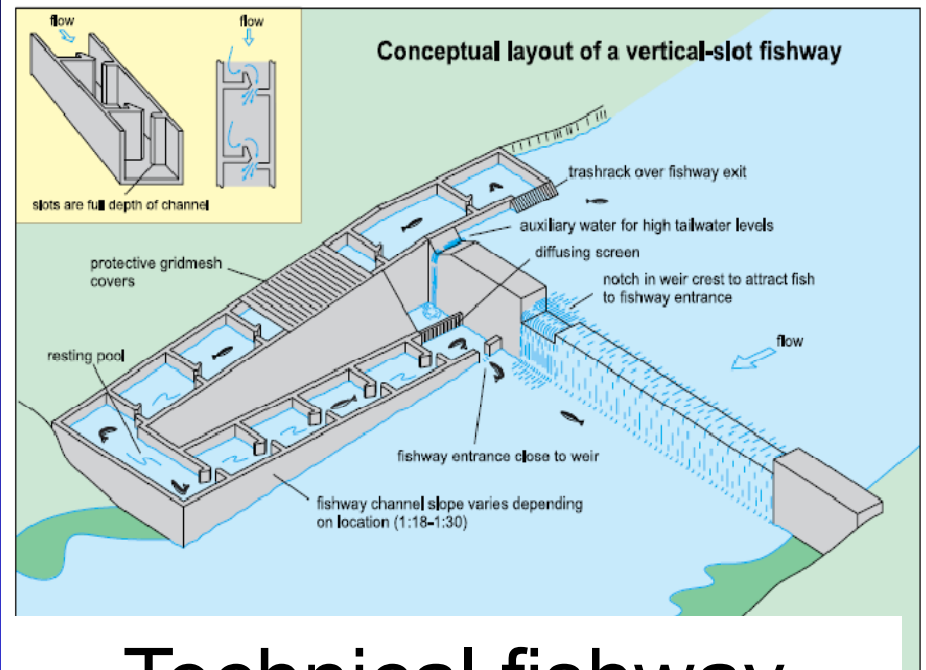
Brown Trout



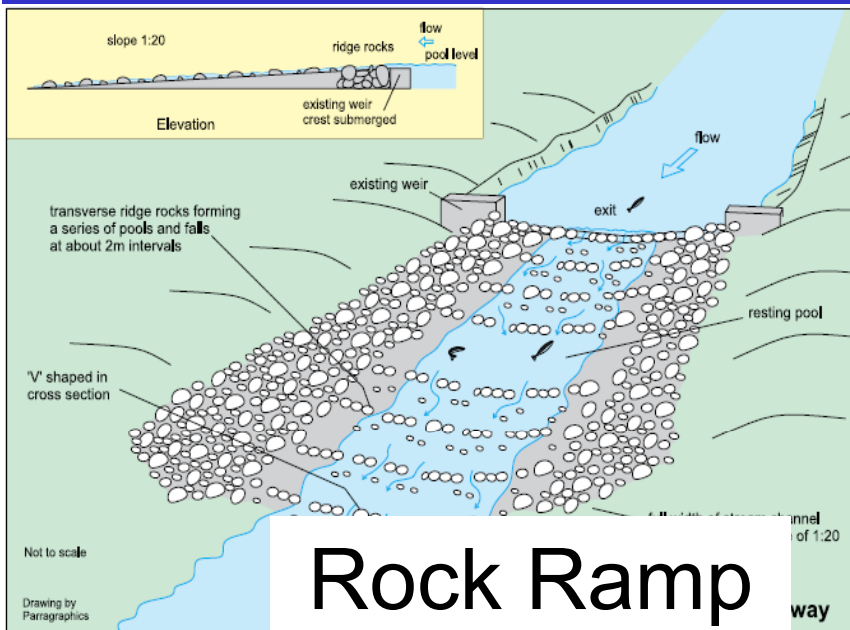
Silver Redhorse



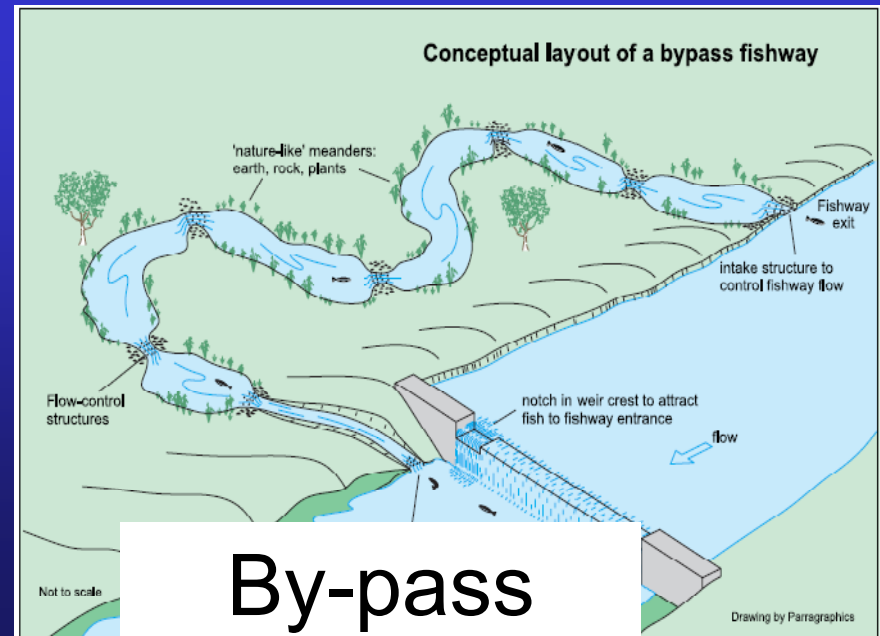
Dam removal



Technical fishway



Rock Ramp



By-pass



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Key Factors for Evaluating Benefits

- Habitat Quantity
- Habitat Quality
- Efficiency of Passage
- How to optimize restoration plan when you have unintended ecological effects

Habitat Unit = Quantity x
Quality

One Team: Relevant, Ready, Responsive and Reliable

Quantity

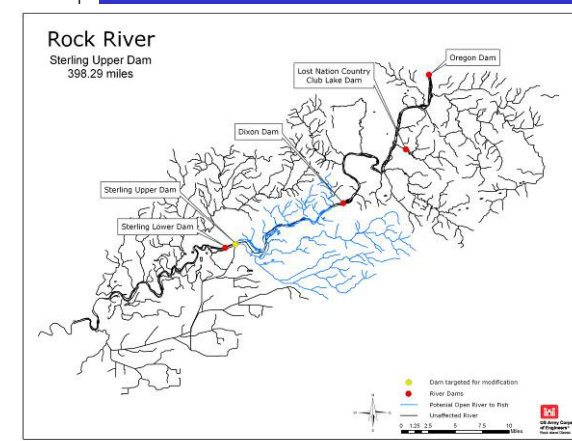
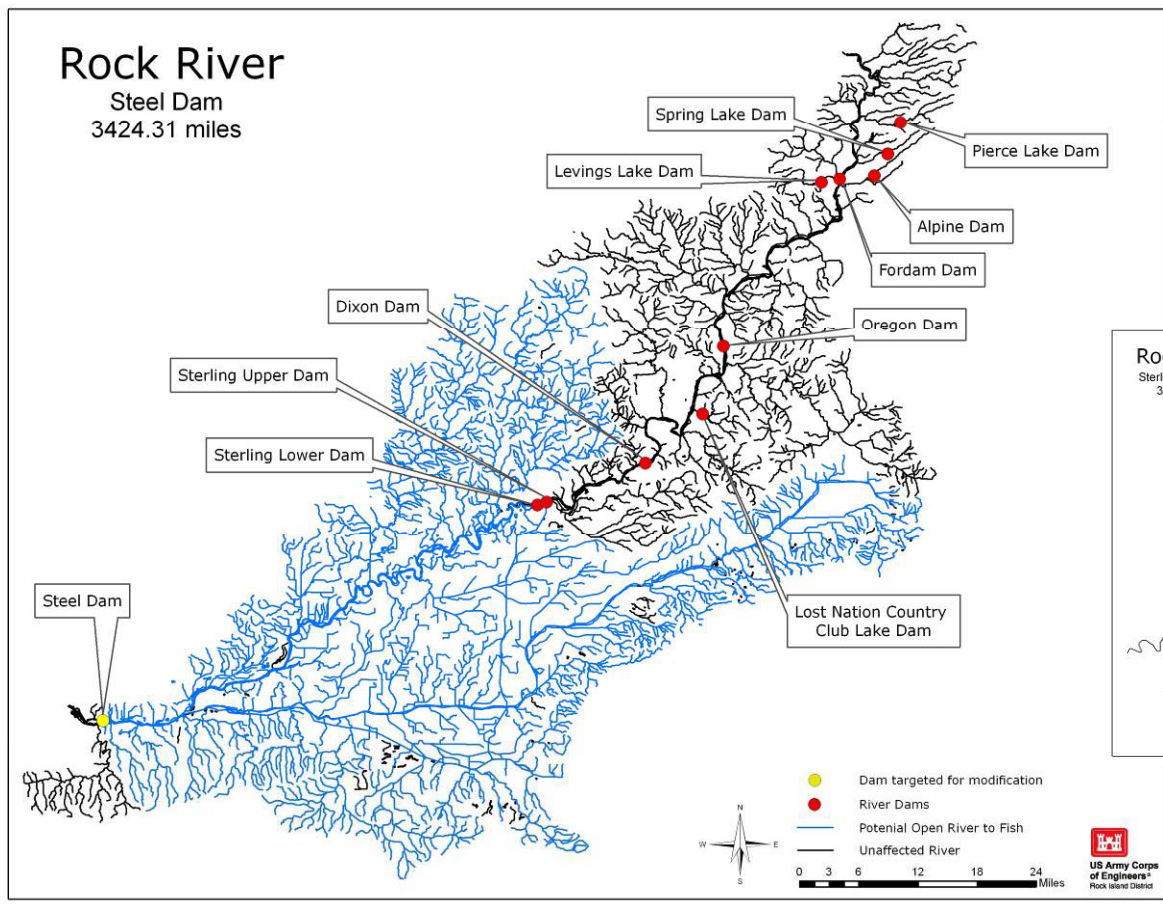
- Connected Stream Miles
- Connected Acres
- Connected miles * Stream order



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Rock River Example



1 dam
~3,400 stream miles

2 dams
~400 stream miles

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UMRS Navigation Study Example

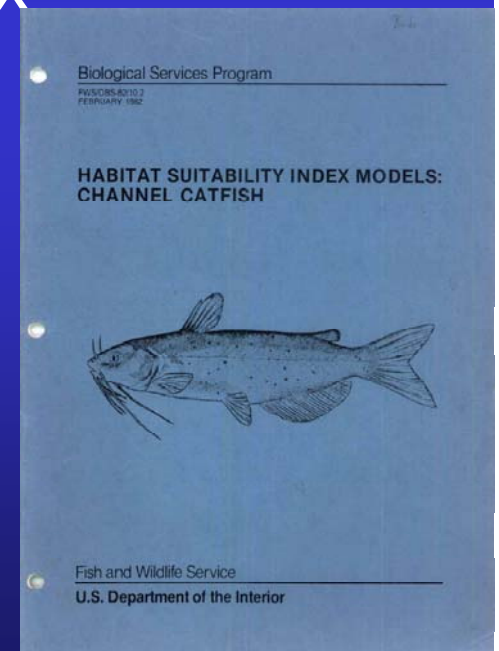
Longitudinal Connectivity Index

$$LCI = \Sigma (\text{unobstructed stream length} \times \text{stream order})$$

Pool 13	Connected Distance (miles)	Stream Order	Connectivity
Mill Creek	14.2	4	56.8
Maquoketa River	41.5	6	249
Apple River	13.1	5	65.5
Rush Creek	32.2	4	128.8
Plum River	39.4	5	197
Elk River	17.6	4	70.4
Pool 13 mainstem	55	9	495
TOTAL LCI			1262.5

Quality

- Habitat Suitability Indices for riverine species
- Qualitative Habitat Evaluation Index
- Index of Biotic Integrity
- Hydrogeomorphic Method





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Northeast example, Habitat Suitability Indices



Alternatives	River Fish HUs	Lake Fish HUs	Wetland HUs	Combined HUs
No Action	91	22	35	148
Dam Removal	202	9	6	217
Denil	152	23	35	210
Bypass	176	23	35	234

One Team: Relevant, Ready, Responsive and Reliable



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Blackberry Creek, Quality Habitat Evaluation Index

- Developed by the Ohio EPA
- Correlates with the Index of Biotic Integrity
- Evaluates
 - substrate,
instream cover,
channel
morphology,
riparian zone, pool
quality, riffle quality,
map gradient





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HUs using QHEI

	QHEI	Distance	HU
Reach 1	64.8	1.22	79
Reach 2	32.4	5.5	178
Reach 3	55.3	0.6	33
Total HUs			290

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Passage Efficiency

Generally,

Removal > Rock Ramp > Bypass > Technical
Fishway





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Passage Efficiency

Evaluate relative efficiency of different alternatives

- Best Professional Judgment, considering
 - Migration timing
 - H&H data
 - Fish swimming abilities
- Can fish find the entrance channel?
- Will there be flow in the channel during migration times?
- What about downstream passage?

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Lock and Dam 3 Example

Passage Efficiency Index = Average P

Where P = Estimate potential for passage
(0= no potential, 5 = high potential)

	Passage Potential	
Species	Alt 1	Alt 2
Lake sturgeon	0	4
Paddlefish	0	4
Mooneye	2	3
Channel catfish	0	3
Smallmouth bass	0	3
	$\frac{2}{5*5} = \frac{2}{25} = 0.08$	$\frac{17}{5*5} = \frac{17}{25} = 0.68$



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Passage Efficiency Index



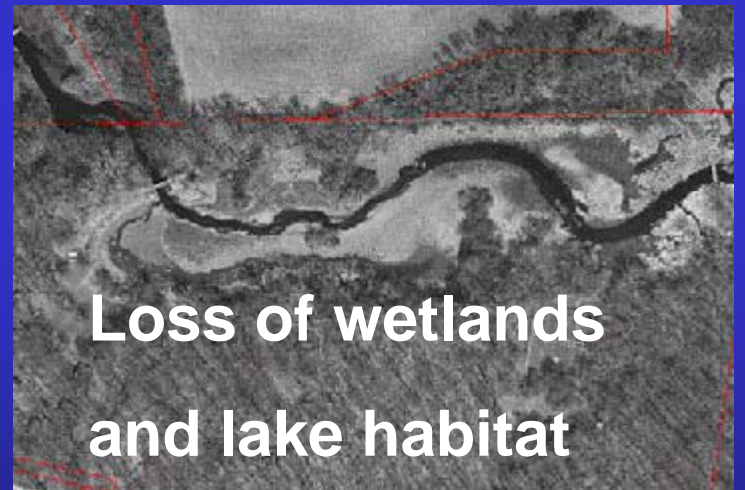
	HU	Passage Efficiency	Total HUs
Alternative 1	100	0.08	8
Alternative 2	100	0.68	68

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Habitat trade-offs



Dam
removal





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Blackberry Creek Example



0.8 acre wetland

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Blackberry Creek Example

Lose wetland, gain quality stream

- Lose 0.8 acres low quality wetland
- Out-of-kind mitigation for over 6 acres improved stream habitat

Regulatory coordination, to be determined ...



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Trade-offs, Northeast Example



Alternatives	Cost	River Fish	Lake Fish	Wetland	Combined
No Action	\$0	91	23	35	149
Dam Removal	\$3,426	202	9	6	217
Denil	\$982	152	23	35	210
Bypass	\$890	176	23	35	234

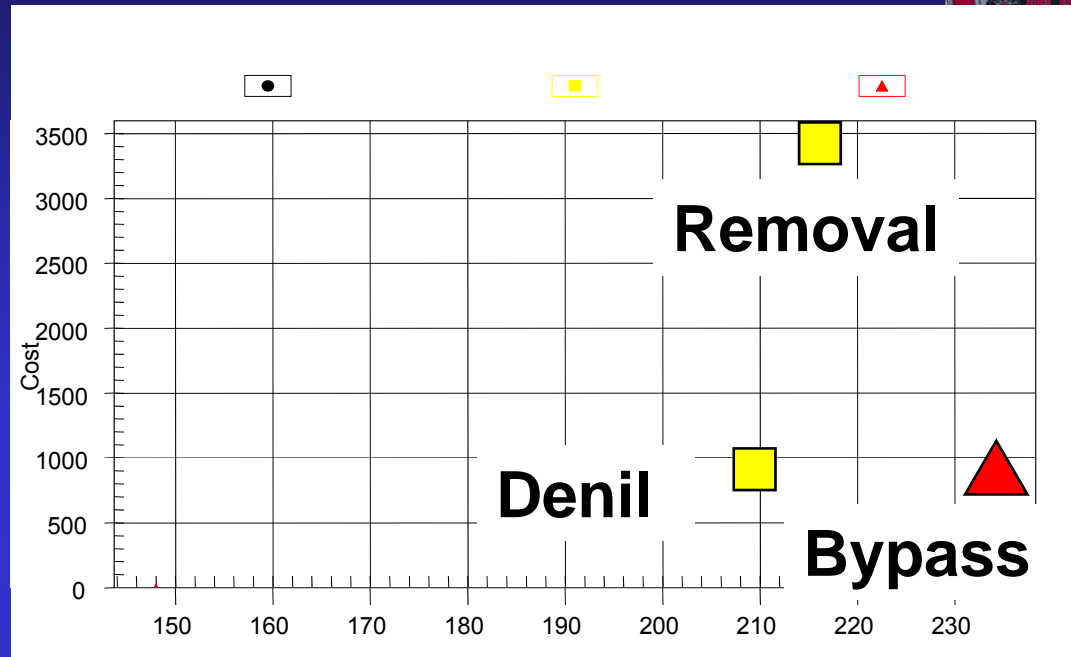
— One Team: Relevant, Ready, Responsive and Reliable —



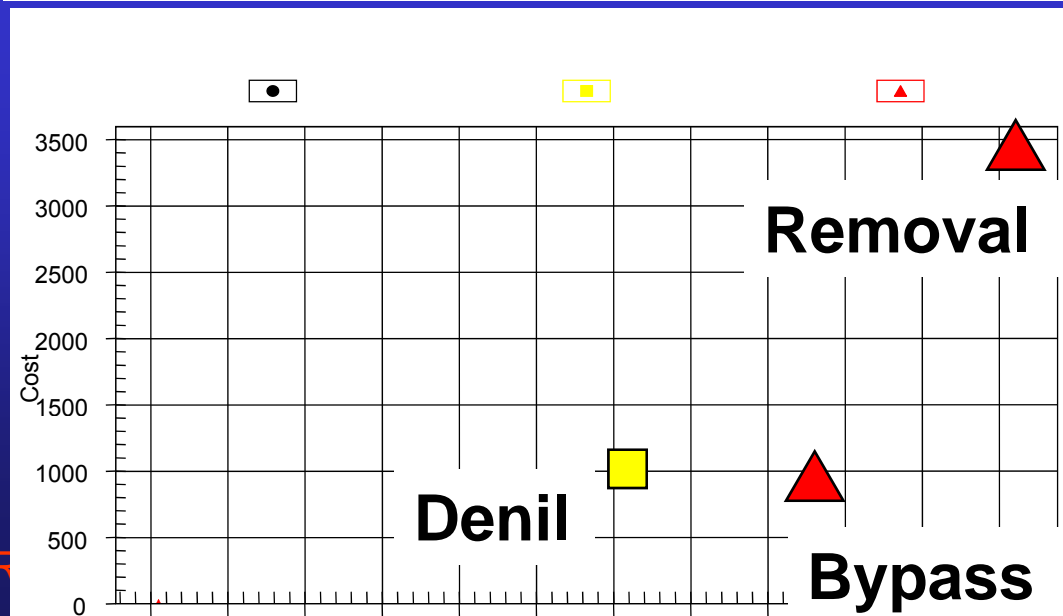
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Combined outputs
= River + Lake +
Wetland

Optimize on River Benefits



River outputs only



One Team: R

Take-away points

- Estimate the quantity and quality of habitat you are reconnecting
- Consider effectiveness of passage, now and with various alternatives
- Don't underestimate the benefits of removal
 - Deal with loss of lake and wetland habitat outside of CE-ICA



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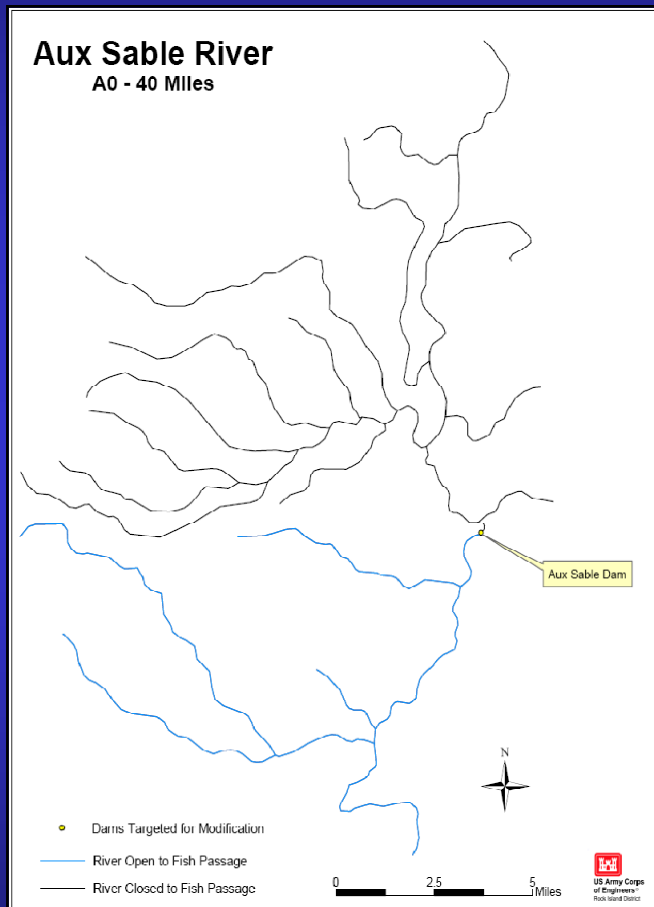
One Team: Relevant, Ready, Responsive and Reliable



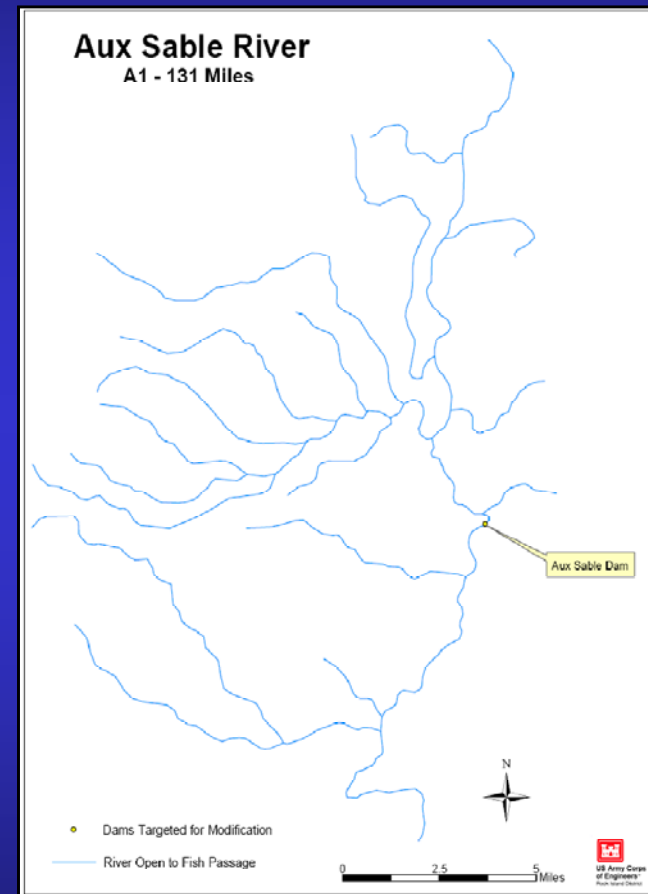
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How much is reconnected?



40 connected miles



131 connected miles

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Why do we evaluate ecosystem benefits?

- Projects justified on non-monetary benefits
- Document significance of restoration
- Measure differences between alternatives
- Evaluation should characterize benefit and adverse effects

Better Decision-Making

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Pool 13	Connected Distance (miles)	Stream Order	Connectivity
Mill Creek	14.2	4	56.8
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Apple River	13.1	5	65.5
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TOTAL LCI			1262.5

UMRS Longitudinal Connectivity Index by Pool

Table 12

Longitudinal Connectivity Index for Each Navigation Pool of the UMRS (Pools shaded green have a high LCI, yellow moderate, and red have a low LCI)

Pool	1	2	3	4	5	5a	6	7	8	9
LCI	93	2669	845	2209	863	497	529	697	1110	1049
10	11	12	13	14	15	16	17	18	19	20
1978	1393	806	1263	1068	251	536	419	2113	2089	1513
					Illinois Waterway					
21	22	24	25	26	La Grange	Peoria	Starved Rock	Marseilles	Dresden	
1143	2576	1255	923	9982	5438	3997	228	641	284	



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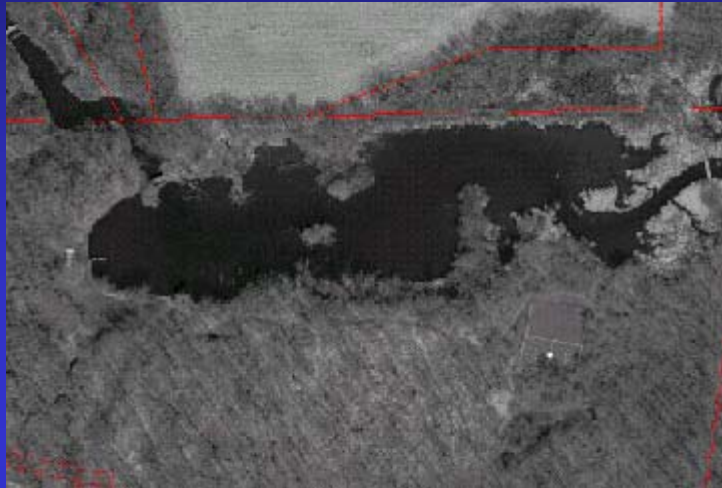


Alternatives

Alternatives

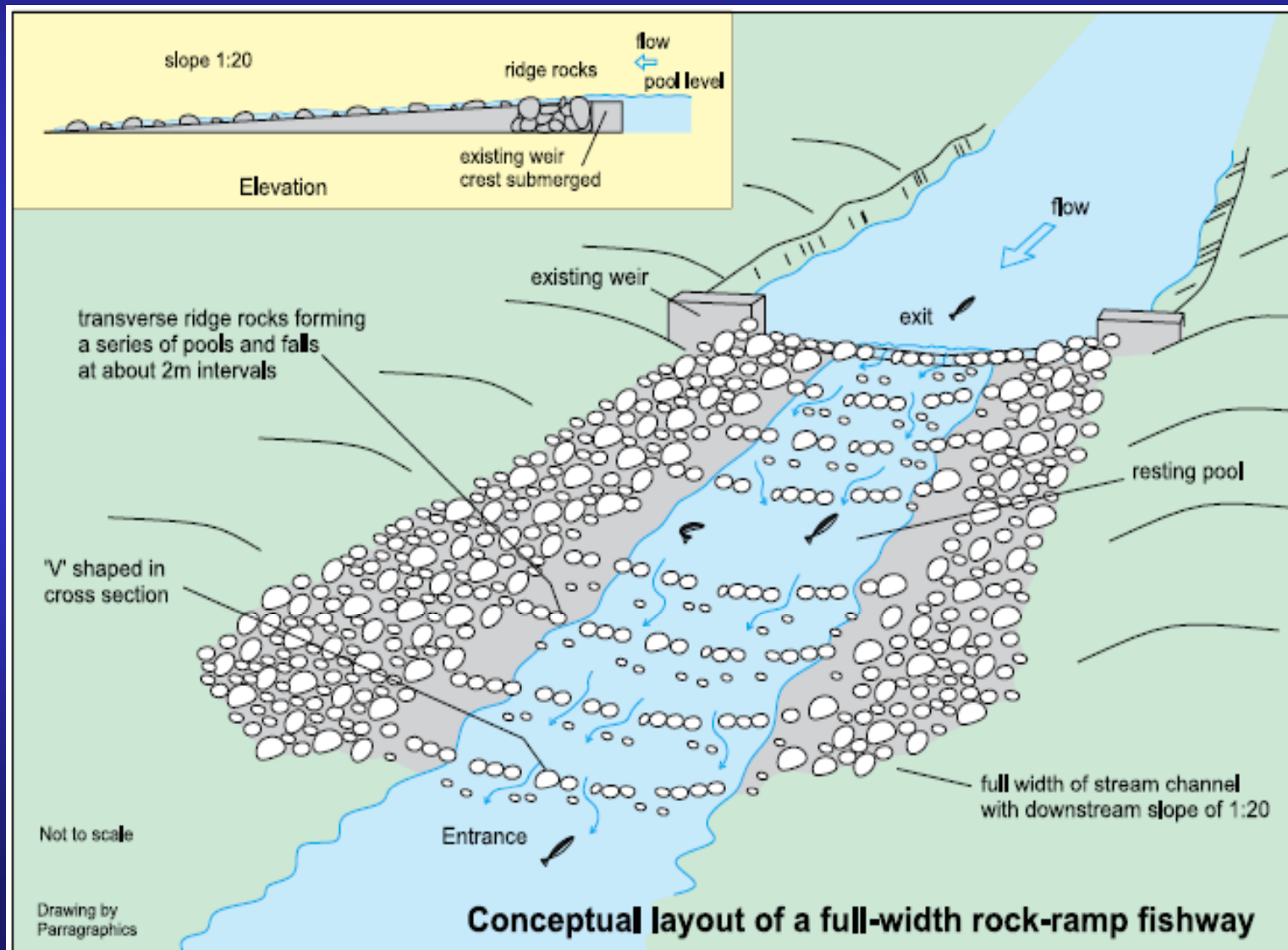
- Dam removal
- Rock ramp
- Nature-like bypass channel
- Technical fishway (Denil, vertical slot, etc.)

Dam Removal



Brewster Creek, Kane County, IL

Rock Ramp

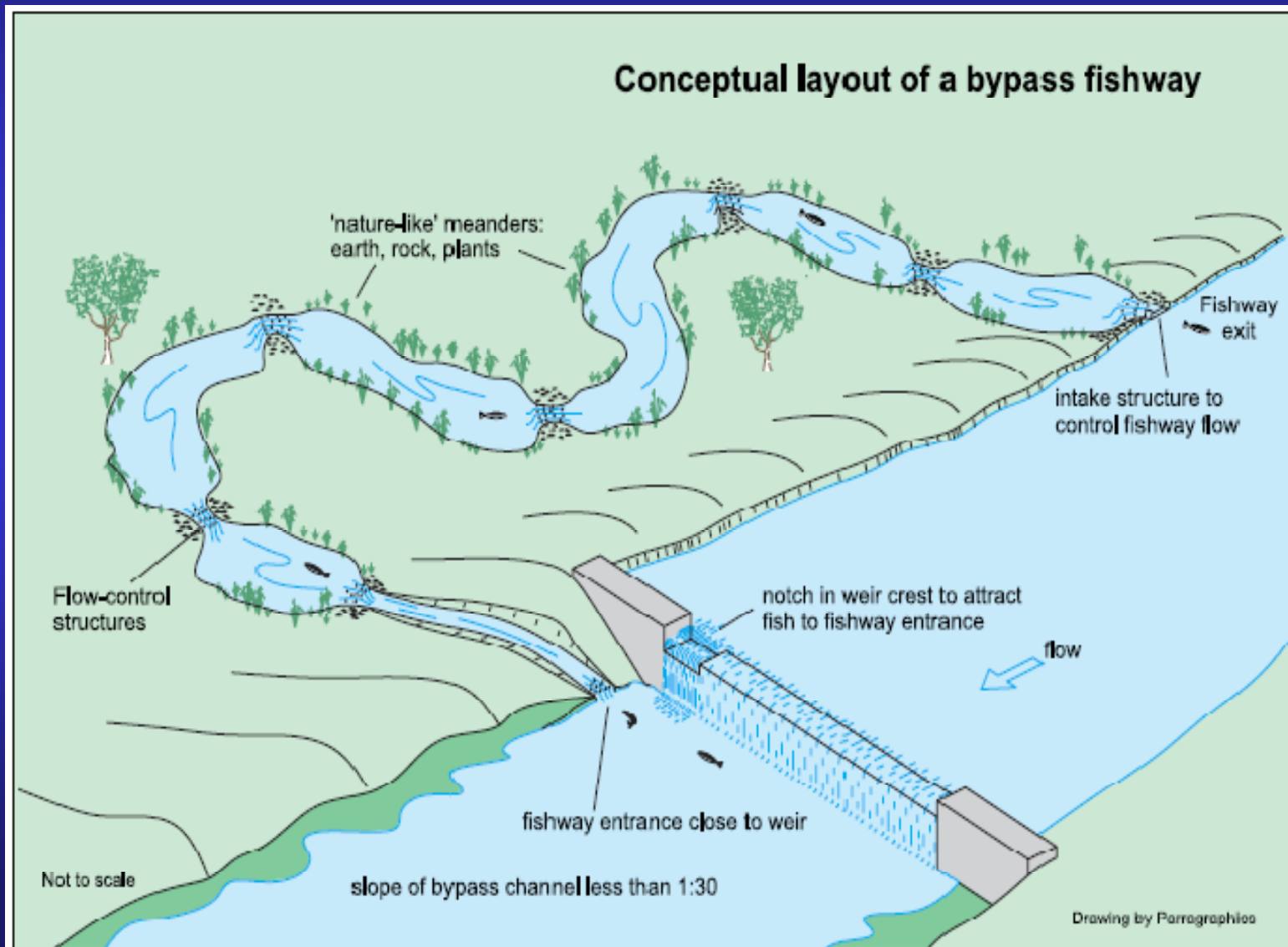


Rock Ramp



Midtown Dam, Fargo, ND

Nature-like Bypass



Nature-like Bypass

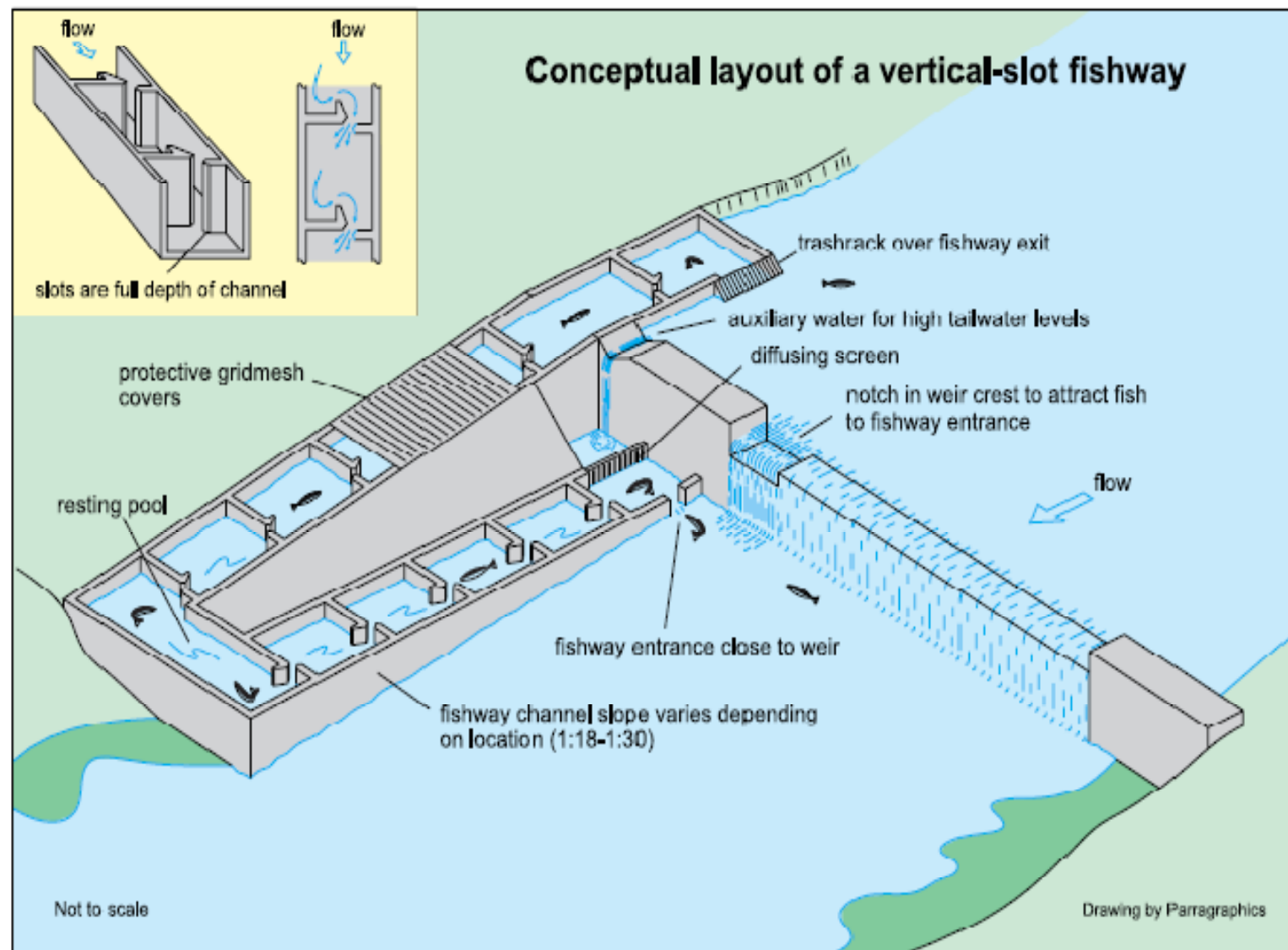


Nature-like Bypass



Fergus Falls, Red River of the North

Technical Fishway



Technical Fishway

